Why do farmers care about rented land? Unravelling the influence of tenure on farmers' soil management

Heidi Leonhardt, Michael Braito, Marianne Penker

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Tel +49 (30) 2093 46845, Email gabriele.wuerth@agrar.hu-berlin.de

Agricultural Land Markets – Efficiency and Regulation

Why do farmers care about rented land? Unravelling the influence of tenure on farmers' soil management

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Abstract

Rental shares of agricultural land are increasing in many countries, as are soil degradation and erosion. Theory suggests that these trends may be correlated, yet empirical findings are ambiguous. This research investigates the relationship between land tenure and farmers' soil management and aims to disentangle the mechanisms involved. We survey Austrian crop farmers and find no differences in farmers' soil management practices between rented and owned land. We consider several explanatory factors such as contract details, landlord-tenant relationships, and plot characteristics and find that these are important factors mediating the conventionally assumed negative effect of cropland leasing on soil conservation.

Keywords: Property rights, Land ownership, Land rental, Soil conservation, Farmer behaviour, Landlord-tenant relationship

JEL codes: Q150, Q240

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* Heidi.leonhardt@boku.ac.at, Institute for Sustainable Economic Development, University of Natural Resources and Life Sciences Vienna, Austria

1 Introduction

Rental shares of agricultural land have been rising in recent decades and are still increasing in many countries of the Global North. Agricultural land sales markets are often extremely tight, as landowners are reluctant to sell land and instead keep it as a secure asset (Ciaian et al. 2012a; Ciaian et al. 2012b). As a result, farm expansion largely happens via the land rental market. Therefore, as farms have grown in size (e.g., the average farm size in the EU-27 countries has increased by 40% from 2005 to 2016 (Eurostat 2018)), rental shares of agricultural land now exceed 50% in many EU member states (Ciaian et al. 2012c). A similar trend towards an increasing number of part-tenants has been observed in the US (Bigelow et al. 2016).

In light of concerns about soil loss and degradation, this increase in rental shares has become a matter of interest for policymakers and scientists. There is a general preconception that only owner-operators have an adequate incentive to conserve soil and invest in practices that will pay off in the long run. In contrast, tenants are assumed to be short-term, bottom-line oriented and thus more likely to neglect soil conservation measures with a long pay-back period. This assumption runs through most work on the relationship between renting and soil management (Carolan et al. 2004; Ranjan et al. 2019; Prokopy et al. 2019).

Two strands of literature investigate such an impact of tenure status on farmers' soil use practice. The first strand focuses on the adoption of farming activities such as agricultural best management practices (BPM) or of programs such as agri-environmental schemes (AES) and often includes tenure as one explanatory variable among others. However, several reviews of this literature show that the relationship between land tenure and BPM or AES adoption is, if even significant, unclear. For an overview, see Lastra-Bravo et al. (2015) for EU countries; Prokopy et al. (2008), Baumgart-Getz et al. (2012), Carlisle (2016) and Prokopy et al. (2019) for the US; and Knowler and Bradshaw (2007) and Wauters and Mathijs (2014) for a more global overview. Only one review by Ranjan et al. (2019) finds that renting of agricultural land is consistently considered a barrier to the adoption of the Conservation Reserve Program (CPR) in qualitative studies in the US.

The second strand of literature is dedicated exclusively to the investigation of a 'tenure effect', aiming to explain either farm management behaviour and outcomes (such as investment or efficiency) or soil conservation efforts based on tenure status. Results here are similarly ambiguous. For the Global South, where tenure and in particular the renting of land is often insecure due to weak institutions, results tend to be somewhat confirming the assumption that increased tenure security fosters investments of various kinds (Lawry et al. 2014; Higgins et al. 2018), but there is also contradictory evidence (Place 2009; Fenske 2011). Research from the US dates as far back as the 1930s (Schickele and Himmel 1938), with interest increasing again in the 1980s (Lee 1980; Ervin 1982; Dillman and Carlson 1982; Lee and Stewart 1983; Derr 1987) and since the early 2000s. Already early studies find mixed evidence of a potential tenure effect, with, for example, Lee (1980) finding no effect of tenure on soil loss but Ervin (1982) finding the opposite, and Van Vuuren and Ysselstein (1986) finding a significant negative effect of renting for several conservation measures by Canadian farmers. Lee and Stewart (1983) find renters to be more likely to practice minimum tillage than owners. Later,

Cole and Johnson (2002) find no tenure effect for soil loss for US farms, whereas Soule et al. (2000) do find an effect for conservation practices such as minimum tillage, as does Fraser (2004) for Canada and the planting of soil conserving crops. More recently, Varble et al. (2016) find that tenants are more likely to use conservation tillage than owners, but less likely to rotate crops and Deaton et al. (2018) find a tenure effect for cover crops, but this effect is contingent on lease length and the farming background of the landlord. For Europe, only a handful of studies exist. Myyrä et al. (2005) and Walmsley and Sklenicka (2017) investigate soil quality parameters for Finland and the Czech Republic, respectively, and find a negative tenure effect. Sklenicka et al. (2015) find a negative effect of renting on crop choice in the Czech Republic, while Leonhardt et al. (2019) find only very small effects for crop choice in neighbouring Austria.

Thus, the literature to date appears inconclusive regarding the conventionally assumed negative effect of cropland renting on soil management. One lesson that can be drawn from this is that a potential tenure effect is probably highly contextual, depending on the farming practice under question, the region investigated, as well as details of tenure and the landlord-tenant relationship. Details of rental arrangements are taken up in few studies, including differentiating between share renters and cash renters (Ervin 1982; Soule et al. 2000), considering information on lease length (Fraser 2004; Deatonet al. 2018), or focusing on absentee landlords (Dillman and Carlson 1982; Petrzelka et al. 2013; Petrzelka and Armstrong 2015). In addition, other aspects such as the relationship between landlords and tenants have been investigated in the context of rental prices (Kuetheet al. 2018; Taylor and Featherstone 2018), but have also been suggested as a potentially important aspect for conservation by Carolan (2005) and Leonhardt et al. (2019). A comprehensive and more detailed investigation of all these factors is, however, missing from the literature. Moreover, most studies focus on a single or a small number of conservation measures, making it difficult to generalise findings for other practices.

Our study aims to fill this gap in the literature by considering a wide array of different practices as well as several aspects of renting. These include the length and security of rental, characteristics of the landlord-tenant relationship, and plot-level features of the land. We thus provide an unprecedented level of detail, which, we hope, will clarify previous investigations of the topic and help refine theoretical considerations of tenure and soil management. As no secondary data that cover such information are publicly available, we collected data via a questionnaire survey with Austrian part-tenant farmers.

In particular, this study aims to answer two research questions. First, we examine our dataset with respect to the existence of a tenure effect for a variety of soil management practices, and answer the question: *Do farmers apply different soil management practices on rented and owned cropland?* Second, we use the additional information gathered to investigate several circumstances of leasing and their potential supporting or counteracting impact on the purported tenure effect, and answer the question of *which underlying mechanisms potentially support or counteract an effect of tenure on soil management?*

The underlying theoretical model can be described as follows: Tenure is one determinant of the soil management practices that farmers apply on their plots of cropland. We focus on renting (where landowners transfer part of their rights to a tenant for a limited period of time) as opposed to full ownership. In line with the literature mentioned above, we assume that

farmers are less concerned about soil conservation on rented plots than on plots they own and thus apply fewer soil-conserving practices. This, we assume, is due to the lack of full ownership rights and a shorter planning period. Leaseholders are less likely to reap the benefits of conservation investments, particularly those with a long pay-back period, than owners. However, we further assume—and know from previous research—that other factors may influence the existence or intensity of this purported relationship. Considering aspects that are applicable only to the individual plot or rental contract, we expect the following factors to play a role: the length and security of rental, plot characteristics such as its distance to the farmhouse or particular farming difficulties, requirements specified in the rental contract, the rental price, and the relationship tenants have with their landlords (including kinship or other personal ties as well as whether the landlord is residential or absentee). Moreover, there are farm-level aspects that may impact the existence and intensity of a tenure effect. These include the general attitude of the farmer as well as participation in AES that need to be applied to an entire farm operation.

We conducted our study in Austria, a country that follows the general trend of structural change in agriculture with increasing farm sizes and increasing rental shares. A particularly interesting feature of Austrian agriculture is a strong focus on sustainable farming techniques, including comparably high shares of organic farming and strong support for and uptake of voluntary AES. The next section briefly introduces these and other particularities and developments of the Austrian agricultural sector. We then describe the questionnaire and the methods used for analysis. The following section presents the results, before we conclude with a discussion of both research questions and potential implications.

1.1 Study area: Austria

In the past decades, the number of farms in Austria has decreased steadily, while the utilized agricultural area (UAA) per farm has increased from 12.6 ha in 1990 to 19.7 ha in 2016 (BMLFUW 2017). Compared to many other European countries with a similar historical and economic development, Austrian agriculture, however, remains relatively small structured. This is mostly due to the alpine nature of Austria's geography, which also makes dairy and livestock production the most important agricultural sector. Crop production is predominant only in the country's relatively flat North-East and South-East. Austria's accession to the EU in 1995 has not altered on ongoing trend towards larger farms, but has changed the institutional setting of subsidies and AES. Austrian agricultural policy is now guided by the Common Agricultural Policy (CAP) of the EU with its two pillars of production support (first pillar) and rural development (second pillar). Being part of the second pillar, AES are of major importance for Austrian farming. All AES are implemented in the so-called ÖPUL program, which is designed to be comprehensive and crowd-in as many farms as possible (BMLFUW 2015). As a result, 83% of all farms covered by the Integrated Accounting and Control System (IACS, comprising all farms that receive any subsidies) received AES payments for, on average, three different schemes in 2018. Farmers usually sign up for these schemes for a period of five or six years within a given CAP period (2015/2016-2020 or 2017-2021). Organic farming is also subsidised within the ÖPUL program, with almost one-quarter of UAA and 18% of cropland being farmed organically in Austria (BMLFUW 2019).

Renting of agricultural land is of increasing importance for Austrian farmers, and crop farmers in particular. Between 1960 and 2010, the amount of rented land has almost tripled (Holzer et al. 2013) and amounted to 39.2% of UAA in 2012, the last year where this information is available in detail. The share of part-tenants has increased from 41.9% in 2001 to 69.6% in 2012 (BMLFUW 2002; BMLFUW 2013). The share of rented land varies by region, ranging from 24.6% in the mountainous mid-west to 63.6% in the east and is higher for cropland (43.8%) than for grassland (32.7%) (BMLFUW 2013, all data are for 2012). Fixed cash rental arrangements are predominant, with sharecropping being virtually inexistent. Rental prices, contract durations, or other contract specifics are not centrally collected or published. The law on agricultural land renting includes reference durations of five to fifteen years for the renting of different types of agricultural land as well as the concept of an 'adequate rent', which are, however, not binding restrictions but rather reference points for conflict resolution (Holzer et al. 2013).

2 Data and Methods

As part of a larger project on rental and ownership of cropland in Austria, we designed an online questionnaire for Austrian farmers participating in the farm accountancy and data network (FADN). This network is used to gather annual micro-economic data for official reports at the EU level and is administered by an Austrian tax and accountancy consultancy firm on behalf of the federal ministry. This firm assisted us in pretesting the questionnaire, identifying and contacting farmers, disseminating the questionnaire, and ensuring an adequate response rate. We invited all FADN-farmers who farm at least 5 ha of cropland and rent part of this land (approx. 1100 farms) to participate in the study in winter 2017/2018. 344 fully completed questionnaires were returned, out of which one had to be excluded since the respondent did not rent any cropland. This response rate of over 31% ensures reasonable statistical power (Faul et al. 2007). For the analyses comparing rented and owned plots directly, we had to exclude another five respondents as they did not own any of their cropland.

2.1 Questionnaire design

Insights from previous work in the larger project (exploratory stakeholder interviews, plot-level secondary data analysis, semi-structured interviews, a Q-methodological study) enabled us to identify critical aspects of cropland renting that we included in the questionnaire. In particular, these were the distance between a plot and the farmhouse, other plot features, tenants' relationship with landlords, and rental duration and security. The questionnaire consisted of three main parts and took participants about 20-30 minutes to complete.

Part one contained general questions on the leasing of cropland, including the amount of land rented, its distance to the farmhouse, from whom it was rented, and rental conditions (type of contract, length of rental, specific requirements, rental price).

In part two, respondents were asked to select a typical rented and a typical owned plot that they farm and provide further details. First they were asked whether they applied any of the following soil management practices on these plots: conservation tillage (including no-till, strip-till and mulch till), use of machinery that prevents soil compaction, precision farming, application of compost, applying no fertilizer, no pesticides, no sewer sludge, no fungicides,

organic farming, a diversified crop rotation, cultivation of cover crops (with a choice of two different intensities in line with AES – covering 10% or 85% of cropland at all times), cultivation of winter-hardy cover crops, preservation of valuable landscape elements, regular soil testing, and creation of wind protection elements (such as hedgerows). Many of these practices are part of voluntary AES. Second, respondents were asked to provide some characteristics of their typical rented and owned plots, such as farming difficulties, its distance to the farmhouse, and their relationship with the (previous) owners of these plots.

In the third part of the questionnaire, we asked respondents about their observations about other farmers' conduct on rented and owned land and their reasoning why they think other farmers behave the way they do; a topic that had come up in previous interviews.

The last part of the questionnaire gathered some demographic information and included an open question to give respondents the possibility to raise any additional aspects of rental and soil management that they thought were important or missing. Providing interesting additional information, 83 (24%) respondents made use of this opportunity.

2.2 Data analysis

To answer the first research question, we compare respondents' stated soil management practices on their typical rented and owned plots. To assess the statistical significance of differences, we use a McNemar's test statistic (McNemar 1947). This test uses 2×2 contingency tables (typical rented vs. typical owned plot, practice applied vs. not applied) with matched pairs to determine whether the frequencies of the practice under question being applied on only one kind of plot are equal. The corresponding null hypothesis is 'the proportion of farmers applying the practice on their rented plot only equals the proportion of farmers applying the practice on their owned plot only'. In addition, we create a simple aggregate index of management differences by summing up the number of practices applied on the typical rented plot and subtracting the number of practices applied on the typical owned plot. We use descriptive statistics (counts, percentages, means) to analyze respondents' observations concerning other farmers, as well as a content analysis with inductive coding of the corresponding open-ended questions (Mayring 2015).

To address research question two, we analyze the more detailed aspects of the rental conditions of the typical plots, general information gathered on the circumstances of renting in general, and the answers to the corresponding open-ended questions. We compare plot-related variables (distance to the farmhouse, farming difficulties) for farmers' typical rented and owned plots, using Wilcoxon signed-rank tests (for the continuous and non-normally distributed variable) and McNemar's test statistics (for the yes/no variables on the presence of specific farming difficulties). We use an ANOVA and Tukey's honest significance test (Tukey 1949) to examine how the aggregate index of management differences differs by landlord types. To describe general rental conditions that may influence a potential difference between rental and ownership as well as respondents' observations relating to other farmers, we use descriptive statistics (counts, percentages, means) of quantitative responses and a content analysis of qualitative responses. A content analysis of the responses to our final open questions asking for additional comments provides additional qualitative insights.

All data handling and analysis was conducted with R (R Core Team 2018) using base functions and the data.table package (Dowle and Srinivasan 2019), figures and graphs were produced using the package ggplot2 (Wickham 2016). The software package atlas.ti was used for qualitative data analysis.

2.3 Descriptive information on respondents and rental

Respondents were, on average, 49 years old (19-69), mostly male (87%), and had been farming for an average of 21 years (0-57 years). The most common educational level of respondents was 'master craftsman' (146 respondents), followed by specialised agricultural school education (without final secondary school graduation permitting university entrance, '*Matura'*) (79 respondents) and *Matura* (60 respondents). The rest completed compulsory school (11), an apprenticeship (25), or had a degree from university or technical college (19). The majority of respondents were located in those federal states of Austria where arable land is prevalent: Lower Austria (164), Styria (65), Upper Austria (48), and Burgenland (33). We received no questionnaires from Vorarlberg, 1 from Tyrol, 2 from Salzburg (all in the mountainous west), and 10 from Carinthia (most southern state)[1].

The average farm size of respondents was 49.6 ha (median: 37 ha) of arable land, of which 44% was rented. Most respondents (57%) farmed more owned than rented cropland. Regarding contractual arrangements, 57% and 42% of respondents had written rental contracts without and with help from outside (extension services, a notary, etc.), respectively. 31% had verbal contracts[2]. In terms of hectares, most land was rented under written contracts (82% of rented cropland). 92.5% of rented land was rented in exchange for monetary rent, slightly over 2% for non-monetary benefits, and just over 5% for no compensation. Rental rates ranged from 0-900€ per hectare, with a median of 300€/ha.

3 Results

3.1 Research Question one: The existence of a tenure effect

Table 1 reports the results on the 16 different soil management practices and whether there are differences in their application between farmers' typical rented and owned plots. The most frequent soil management practices applied on both rented and owned plots were crop rotation (94.4%) and the cultivation of cover crops (on 10% of all cropland) (81.1%). In contrast, 92% of respondents indicated not creating wind protection elements on either rented and owned plots, and just over 85% indicated not using precision farming, and not applying compost.

[1] Includes only those respondents that provided a correct and unique FADN-identifier, enabling us to access information such as the federal state of residence, farm type or economic data.

[2] Since farmers can have several different contractual arrangements these percentages do not sum to 100.

Table 1: Comparing farmers' practices on their typical rented and owned plots.

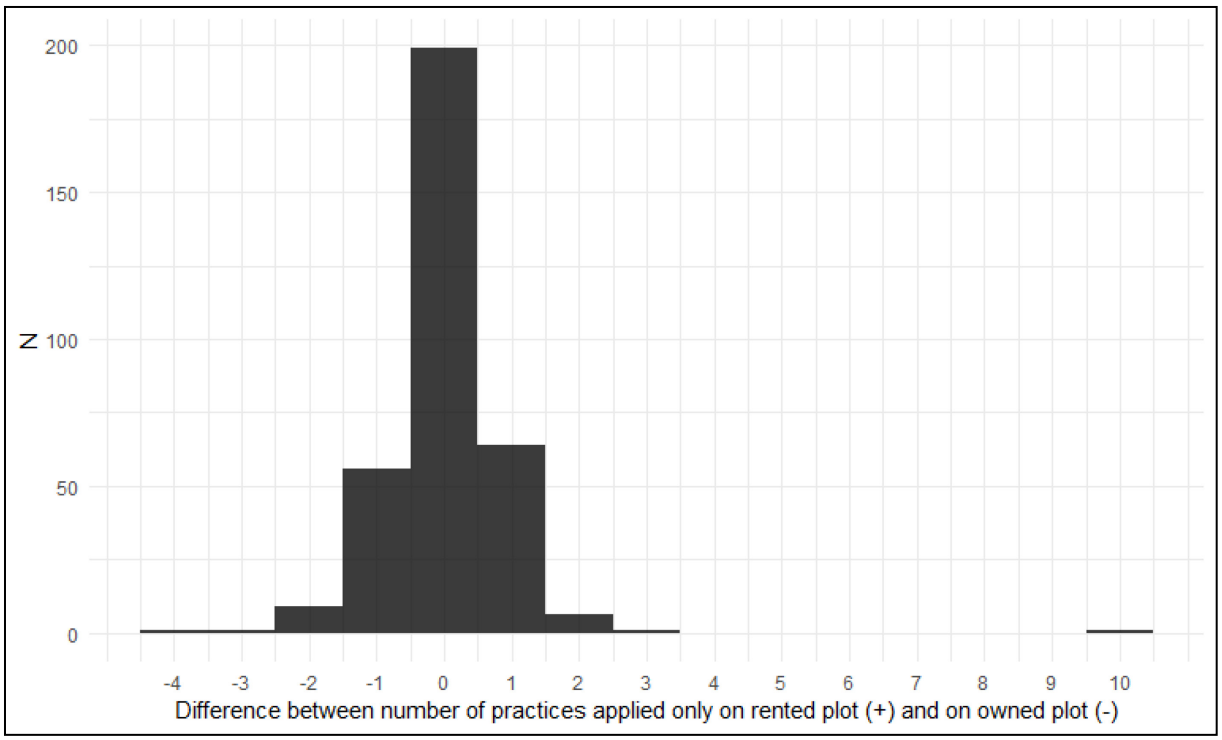
	stated soil management practices					**test statistics**
Which soil management practices do you apply on your typical rented/ owned plot?	on **BOTH**	on **NEITHER**	on **EITHER**	on **rented only**	on **owned only**	matched pairs
	n (%)			n		χ^2 (*p*-value)
conservation tillage	163 (48.2)	163 (48.2)	**12 (3.6)**	8	4	0.75 (0.39)
soil protecting machinery	112 (33.1)	213 (63.0)	**13 (3.9)**	5	8	0.31 (0.58)
precision farming	44 (13.0)	290 (85.8)	**4 (1.2)**	2	2	0 (1)
compost	31 (9.2)	289 (85.5)	**18 (5.3)**	8	10	0.05 (0.81)
no fertilizer	54 (16.0)	277 (81.9)	**7 (2.1)**	6	1	2.28 (0.13)
no pesticide	64 (18.9)	264 (78.1)	**10 (3.0)**	5	5	0 (1)
no sewer sludge	163 (48.2)	148 (43.8)	**27 (8.0)**	20	7	5.33 (0.02)*
no fungicide	115 (34.0)	212 (62.7)	**11 (3.3)**	5	6	0 (1)
organic farming	77 (22.8)	256 (75.7)	**5 (1.5)**	2	3	0 (1)
crop rotation	319 (94.4)	11 (3.2)	**8 (2.4)**	3	5	0.12 (0.72)
cover crops (10%)	274 (81.1)	48 (14.2)	**16 (4.7)**	7	9	0.06 (0.8)
cover crops (85%)	96 (28.4)	234 (69.2)	**8 (2.4)**	3	5	0.12 (0.72)
winter-hardy cover crops	84 (24.8)	239 (70.7)	**15 (4.4)**	11	4	2.4 (0.12)
landscape elements	140 (41.4)	148 (43.8)	**50 (14.8)**	23	27	0.18 (0.67)
soil samples	176 (52.1)	134 (39.6)	**28 (8.3)**	14	14	0 (1)
wind protection elements	13 (3.8)	311 (92.0)	**14 (4.1)**	5	9	0.64 (0.42)

Note: * $p < .05$

The results also show that respondents very rarely indicated applying different soil management practices on their typical rented and owned plots. Looking at the number of respondents who applied different practices on rented and owned plots, we see that preserving valuable landscape elements (14.8%), taking regular soil samples (8.3%), and not applying sewer sludge (8%) were the most commonly mentioned. However, there appears to be no clear direction of differences for the former two practices – similar numbers of respondents indicated applying them on their rented or owned plot only. Not applying sewer sludge on plots is the only practice where we see a statistically significant difference at the five-percent level: 20 farmers refrained from using sewer sludge only on their typical rented plot, while seven did so on only their typical owned plot.

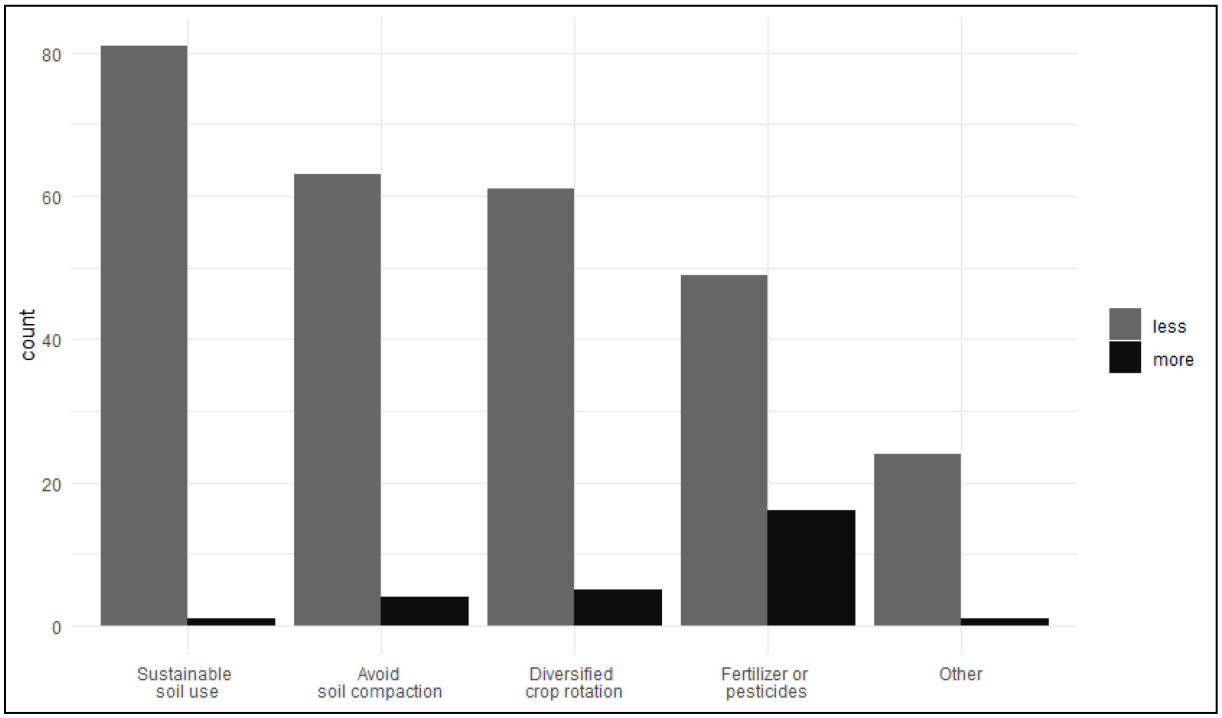
Next, we create the aggregate index of management differences by summing up the number of practices applied on the typical rented plot and subtracting the number of practices applied on the typical owned plot. Figure 1 shows the distribution of this index, confirming again that there is no clear direction of differences: A majority of farmers applied the same number of practices on both their plots (index = 0), and similar numbers differ by one (or more) practices in either direction (i.e., a similar number of respondents apply one more practice on their rented plot than on their owned plot as the other way around).

Figure 1: Histogram of the aggregate index of management differences between rented and owned plots.



Looking at whether farmers report observing *other* farmers applying different practices on rented and owned plots, 104 out of the 343 respondents (30.3%) stated that they do so, whereas the other 239 (69.7%) stated that they do not observe a difference. Those who observe a difference mostly observe less careful soil tillage (83), less prevention of soil compaction (65), and a less diversified crop rotation (63) on rented fields compared to owned fields (Figure 2). Those 25 farmers who observed "other" differences were asked to provide more detail in a text field. Their answers largely reflect the suggested practices, but in addition some respondents mentioned that others, on their rented land, cultivate soil that is too wet, neglect liming, use less cover crops/catch crops, and focus on "short-term profit" and "intensively getting everything out of it". The topic also recurs in the open-ended general question at the end of the questionnaire. Here, farmers mentioned differences in liming and the application of phosphorus-potassium fertilizer to the detriment of rented lands, as well as more humus formation on rented plots compared to owned plots.

Figure 2: Responses to "What do other farmers do differently with the soil on their rented land compared to their owned land?" (only respondents who indicated observing a difference).



3.2 Determinants of a tenure effect

Regarding our second research question (Which underlying mechanisms potentially support or counteract an effect of tenure on soil management?), we compare the 'typical' rented and owned plots with respect to their characteristics and then relate these characteristics to the indicator of soil management practices introduced above. First, the typical owned plots were on average closer to the farmhouse (mean distance 1.9 km) than rented plots (3.3 km). This difference of 1.4 km is statistically significant ($p < 2.2e^{-16}$). However, there is no statistically significant relationship between the distance of a rented plot to the farmhouse and the aggregate index of management differences ($p = 0.415$).

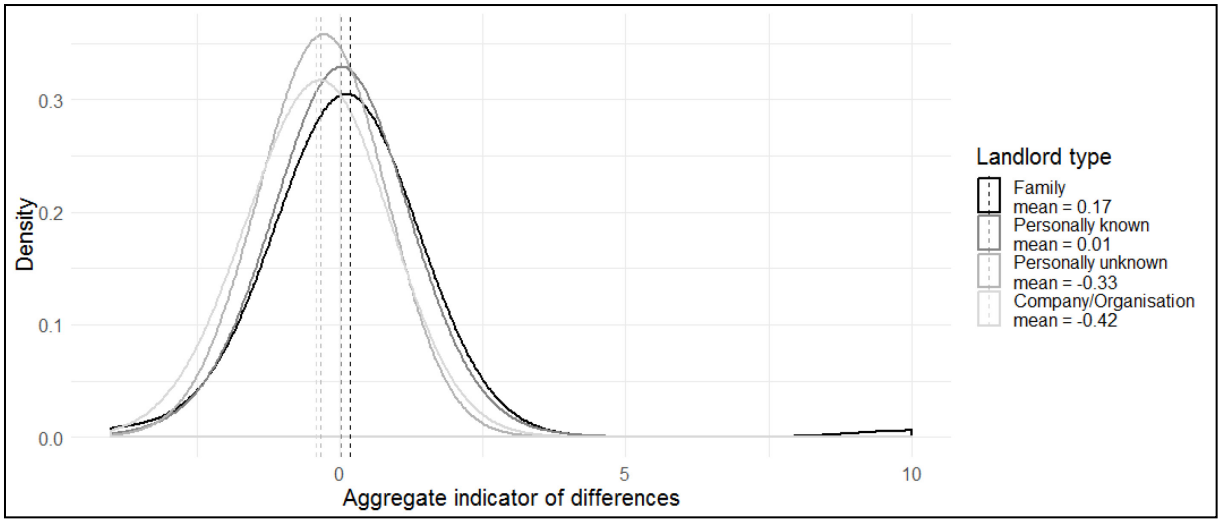
Second, we used three items to assess difficulties farmers are often confronted with on their land and which might force them to apply specific soil management practices: steep slopes, protected area, and poor soil quality. Table 2 depicts the prevalence of these difficulties on respondents' typical plots. While some respondents have to deal with difficulties on some of their plots, we do not find any statistically significant differences in the proportion of difficulties between rented and owned land.

Table 2: Prevalence of plot related difficulties on rented and owned plots.

	stated difficulties				test statistics
Are you confronted with specific difficulties?	on **BOTH**	on **NEITHER**	on **rented only**	on **owned only**	
			n		χ^2 (p-value)
none	218	86	17	17	0 (1)
slope	68	237	13	20	1.09 (0.30)
protected area	18	310	3	7	0.9 (0.34)
poor soil quality	49	253	17	19	0.03 (0.87)

Third, we asked about respondents' social ties with owners or previous owners of their plots. We see that only 4.4% of our respondents indicated renting their typical rented plot from landlords they do *not* know personally or from a company or organisation. All other farmers rent from family/relatives (20.4%) or landlords they otherwise know personally (75.1%). All respondents acquired their typical owned plot either from a previous owner they knew personally, such as family/relatives (95.3%) or others (4.7%). Thus, whether rented or owned, farmers have close social relations with their landlords or previous owners. To gain further insights into the connection between landlord-tenant relations and a tenure effect, we compare landlord types with the indicator of management differences between the two typical plots (see Figure 1). The grouped density plot in Figure 3 shows that the arithmetic means of the aggregate index vary by landlord type as expected: The closer the landlord-tenant relationship, the more practices were applied on the rented plot compared to the owned plot and vice versa. However, these differences are not statistically significant between any two of the four groups according to an ANOVA (p = 0.199) and ensuing Tukey's honest significance test.

Figure 3: Density plot of the aggregate indicator of differences (Number of practices on rented plot - number of practices on owned plot) by landlord type.



Due to the lack of substantial and directional differences between rented and owned plots regarding both characteristics of as well as practices applied on these plots, further comparative and multivariate analyses of the plot-related data did not reveal any statistically significant relationships. We thus do not display any results of such further analyses and models here. However, the more general descriptive and qualitative information from the other parts of the questionnaire provides us with additional insights.

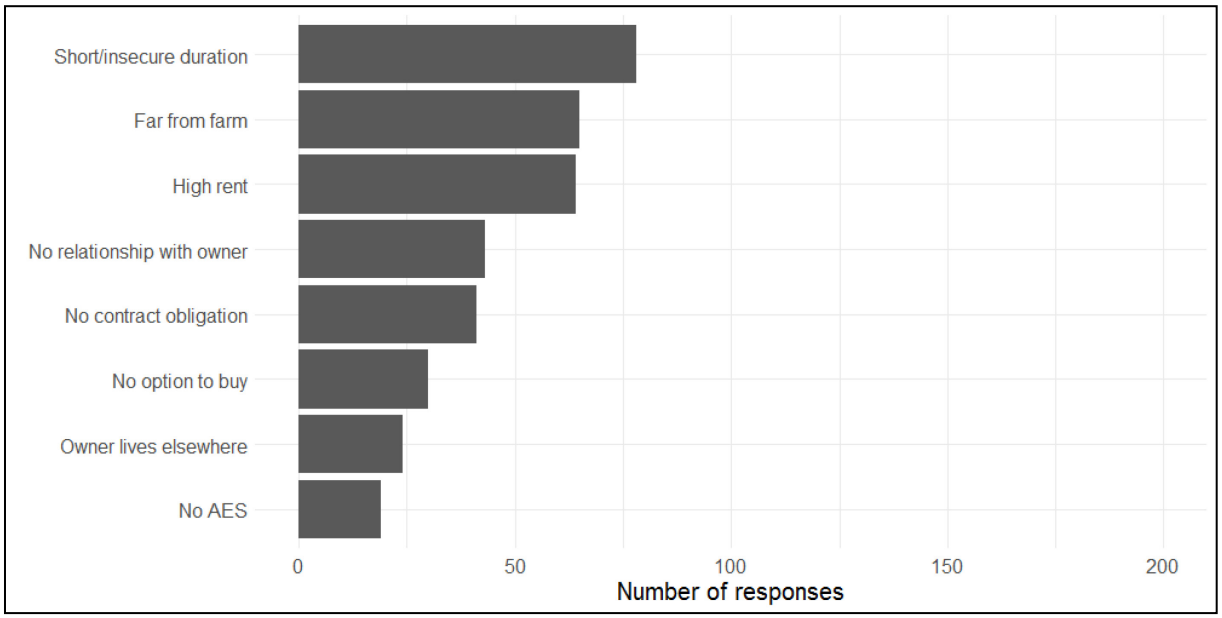
First, we consider the general information on rented cropland that respondents provided in the first part of the questionnaire. This analysis confirms that most of the respondents' rented cropland was typically close to their farmhouse, with 84% of all rented land being within 5 km, and an additional 12% within 10 km of the farmhouse location. Only 4% and 0.5% of rented cropland were between 10 and 20 km, or more than 20 km away, respectively. Moreover, and confirming the results for the 'typical' rented plots, 48% of respondents indicated that they rent some land from family, with the average respondent renting 22.4% of their rented land from family. The majority of rented land, 71.2%, was rented from people that farmers know personally (90% of respondents rented some land from this category of owners), and only 1.6% and 4.6% of rented land were owned by landlords not personally known and by organisations or companies, respectively.

In addition, cropland renting appears to be very secure and long-term for most farmers. A total of 72.2% of rented land was under contracts with unlimited duration (with 85% of respondents indicating that they rent at least some cropland under such contracts). Further 15% of rented cropland was under 5-year contracts, 7.9% under limited contracts longer than 5 years, and only 3.7% under shorter contracts. Of those respondents who indicated having some land with limited-duration rental contracts, 91% indicated that they expect to "likely" (40%) or "very likely" (51%) have their contracts renewed after the end of the rental period (further 8% are neutral and only one respondent considers it very unlikely that his/her contract will be extended).

Considering that landlords may require tenants to use or refrain from particular practices, we asked respondents to indicate whether this is the case for any of their rented land. Most (92%) indicated no such requirements by landlords; 6% (22 participants) reported a prohibition of applying sewer sludge, five were required to avoid soil compaction, while taking soil samples and enhancing the humus-content of soil were each mandatory for three respondents. Two farmers indicated in a text field of the survey that their landowners required them to plant legumes or not plant silage maize, others reported particular requirements tied to specific landscape elements, water protection, or compensation areas. Looking at those 22 participants who mentioned a contractual prohibition to use sewer sludge on some of their rented land, we find that none of these 22 respondents stated that they refrain from sewer sludge use on their rented plot only. On the contrary, 2 out of the 27 respondents who differed between their rented and owned plot with respect to sewer sludge stated that they refrain from the use of sewer sludge on their typical *owned* plot only, thus apparently applying sewer sludge on their typical rented plot. Therefore, contractual requirements do not provide an explanation for the one practice where we find a significant effect of tenure on its application.

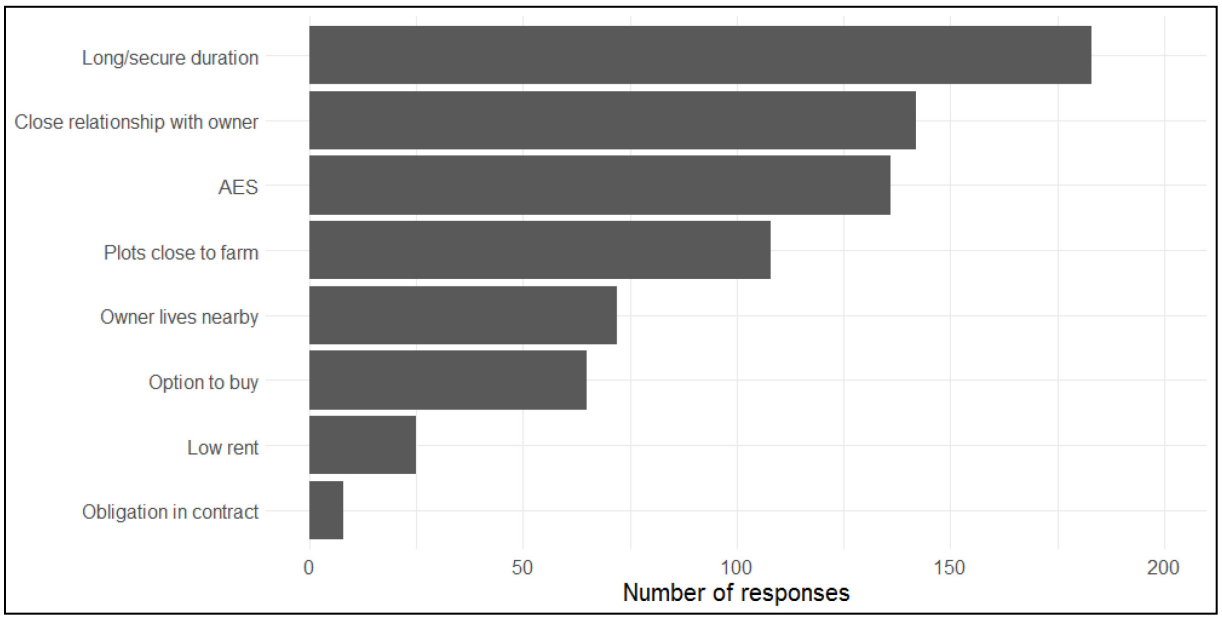
Second, valuable insights can be gained by considering the observations that respondents made about other farmers' soil management. We asked respondents to indicate why they thought others did or did not treat rented land differently than owned land in two closed questions and with the option to provide other reasons or more information in a text field. Figure 4 and Figure 5 present the frequencies of answers to the closed questions.

Figure 4: Responses to "Why do you think do some farmers treat the soil on their rented plots differently than on their owned plots?" (only respondents who indicated observing a difference).



We see that those who did think that others treat rented land differently than owned land largely believed that this is due to short or insecure rental, followed by a large distance between the farmhouse and rented plots, high rental prices, no close relationship with landowners, and no contractual obligations to take care of rented land. In the text field, some respondents added that other farmers want to keep costs down or that treating rented land worse than owned land is due to ignorance by tenants as well as landowners. Those respondents who thought that others treat both rented and owned land equally mainly believed this to be due to long and secure rental, close social relationships with landowners, participation in agri-environmental schemes, and distances between plots and the farmhouse being similar. Frequent additional arguments provided in the text field were that only good soil use ensures good yields and income, that it is easiest to use the same machinery, crop rotation, and work programme on the entire farm, independent of tenure, that plots are often small-structured and intertwined or even swapped between farmers, such that ownership status is blurred, and that it is a general principle for other farmers to treat all soils well.

Figure 5: Responses to "Why do you think other farmers treat the soil on their rented plots the same as than on their owned plots?" (only respondents who indicated observing no difference).



Third, we further analysed the answers to the open question at the end of the questionnaire with respect to arguments that explain (the lack of) a tenure effect. Here, some respondents provided arguments why rented and owned plots are treated differently, one mentioning the distance between farmhouse and the plots differing (leading to less removal of residual straw and thus more humus formation on rented plots), the other one arguing on a very general level that *"on owned soils the owner = operator takes on more responsibility. When the owner is someone else, for sure some responsibility for the soil is lost."* Others provided rationales for why they themselves or others make no difference based on tenure, including again the argument that treating the soil well is important for yields and earnings, that long-term contracts lead to similar treatment, that plots are intertwined and swapped, and that general principles and attitudes of the farmer are more important than property status as illustrated by this quote: *"I treat every soil (whether rented or owned) the same! This is where our food grows, and we should take proper care of this soil!"*

While not directly explaining the *differences* between rented and owned plots, another line of reasoning is recurrent in the answers to the open question: If landlords' main focus is to receive the highest rent possible, the plots end up with farms that are less careful in their soil use than others, either because they are then subject to strong economic pressures or because they generally do not have a conservation mind-set. Two quotes illustrate this to the point: *"The landlord decides whether rented plots are treated decently. If you always want to achieve the highest rent (up to 500€/ha in the neighbouring villages) you have to live with the fact that the tenant will by necessity need to 'exploit' the soil, as otherwise he will have to put money into it [i.e., make a loss]."* and *"High rents evoke an exploitation of the soil – but mostly by farms that do the same on their own plots."*.

4 Discussion

In this paper we aimed to answer two related research questions: Do farmers apply different soil management practices on land they rent compared to land they own? And which other factors support or counteract such a difference? We analysed a questionnaire among 344 Austrian crop farmers to address these questions. Contrary to common expectations, we find no negative relationship between cropland renting and soil conservation. Below we discuss this finding as well as potential explanations based on our results.

In general, most farmers in our sample indicated that they did not vary their soil management practices between rented and owned plots. Some farmers stated for some practices that they differ, but where this is the case (e.g., preservation of valuable landscape elements), we observe an equal number of farmers who apply the measure on rented or on owned land only. Therefore, there is no clear direction of a potential tenure effect, with one exception: Farmers were more likely to refrain from applying sewer sludge on rented land than on owned land. This is contrary to the common argument that renters may be more careless with their soil than owners, if we assume that sewer sludge has the potential to contain heavy metals, microplastic and other problematic materials (while nevertheless being a readily available fertilizer) (Oliva et al. 2009). From anecdotal evidence from extension services as well as from part one of our questionnaire (general circumstances of the rental), we know that a prohibition to use sewer sludge as fertilizer is sometimes included in rental contracts[3]. However, in our case, respondents who indicated that they made a difference had not made such contractual arrangements. Another explanation could be a 'signaling' effect as also described by Leonhardt et al. (2019): Landlords usually know their tenants and might even observe their farming practices. Applying sewer sludge is potentially seen as detrimental to soil and environment in the long run (especially since a general prohibition for all of Austria has recently been discussed). Therefore, tenants may fear that their landlords object to the use of sewer sludge even if not formally required in the contract and adjust their behaviour accordingly.

Although our respondents did not show any differences in their self-reported practices between rented and owned plots, part three of our questionnaire pose a puzzle: a large number of respondents believe that *other* farmers do make such differences. We see four potential explanations for this discrepancy. First, our respondents might have a wrong perception of others' behaviour. This could be caused by projecting preconceived opinions onto others' behaviour without actually observing an effect, similar to effects such as confirmation bias or cherry-picking for evidence (Nickerson 1998; Kahneman 2011). This explanation appears very likely to us, as there is a preconceived opinion among the general public that farmland renting leads to short-sighted behaviour but actual empirical evidence is mixed, in particular for countries of the Global North. Thus, this could be reflected in our questionnaire, with respondents having a preconceived opinion but reality being different. Second, our respondents may have misreported their own behaviour. This could be due to, for example, a social desirability bias (Grimm 2010) or a biased perception of their behaviour. However, since the survey was conducted without an interviewer present (Dillman et al. 2009) and we asked for very specific and potentially testable behaviour with many practices being part of AES that farmers need to actively sign up for, we do not think that this bias is substantial.

[3] Moreover, several federal states as well as some large buyers of agricultural commodities prohibit the use of sewer sludge as fertilizer in agriculture, usually for the entire farm.

Third, our questionnaire might be to blame for the discrepancy, as we did not use the same list of soil management practices in part two (practices on typical rented and owned plots) and part three (observations about others) of our questionnaire, due to the different possibilities and objectives of these two sections. While part two of the questionnaire was designed to compare the application of very specific measures (e.g., using winter-hardy cover crops), part three needed to be more general (e.g., careful soil tillage), as it is hardly possible to observe others' behaviour in such detail. More general aspects of respondents' soil management might therefore not be reflected in their specific answers, such as the timing of measures, care and thoroughness of applying them, or attentiveness to specificities of plots. On the other hand, other farmers' specific practices might not be easily observed by neighbours, leading to an incomplete picture of actual soil management. Fourth, it is possible that our sample of respondents is not representative of the population of all farmers, with respondents being less inclined than others to differ their practices based on property status. As the full FADN sample is designed to be as representative and encompassing as possible, this effect should be small. However, as participation in the survey was voluntary, we cannot exclude the possibility of such a bias.

It seems possible that all of these four explanations apply to some extent, making it difficult to estimate where the "truth" lies. A previous study of agricultural land tenure in Austria has also found a very limited tenure effect based on secondary data from the IACS that is to some extent subject to external cross-checking (Leonhardt et al. 2019). Considering these results, we tend to give greater credence to farmers' self-reported behaviour than to their observations about others. More importantly, however, the potential explanations that farmers provided about why or under which circumstances rented land might be treated differently from owned land provide us with valuable insights.

First, the most common reason that our respondents gave for differing soil management practices by others was a short or insecure lease, while the most common reason for no difference was that leasing is long and secure (cf. Figure 4 and Figure 5). This makes intuitive sense and is a major reason why many countries have minimum rental periods for agricultural land (Ciaian et al. 2012d), providing tenant farmers with a longer planning horizon. Indeed, an overwhelming majority of our respondents indicated that they either have rental contracts of unlimited duration or with limited duration but contract extension being (very) likely. This is one plausible explanation of why we find virtually no tenure effect on soil management. Moreover, a considerable number of our respondents believed that tenants treat their rented land the same as their owned land because they will have the option to buy this land in the future, extending farmers' time horizon for this land even further. Thus, with such prospects for rented land, investments into its soil quality make economic sense for farmers just like for their owned land. The respondents of our questionnaire even frequently raised this argument—only good treatment of the land ensures good yields and earnings—themselves in their answers to the open questions.

Second, a related mechanism that has both an influence on rental security as well as on how farmers treat their land is the relationship between landlords and tenants. Having a close landlord-tenant relationship was given as the second most crucial argument by respondents for why other farmers treat all their land equally, while the lack of a close relationship is the fourth most important reason for a negative effect of leasing. Other studies have found an impact of the relationship between the contractual partners on aspects such as land sales prices, land rental prices, and rental contract type (Perry and Robinson 2001; Bryan et al. 2015; Taylor and Featherstone 2018). While quantitative evidence on this aspect and its impact on conservation behaviour is still missing, we, therefore, consider it likely that close landlord-tenant relationships may explain our findings for research question one. In our questionnaire, we find that the vast majority of respondents rent from family members or landowners that they know personally. This is true both for their 'typical' plots as well as for the majority of their rented land in general. A substantial number of respondents even rent land based on verbal agreements, requiring a certain level of trust that most likely requires knowing each other personally. Therefore, while we do not know any more details about how well tenants and landlords know each other, it is likely that these close personal relationships decrease a potential adverse effect of renting, as they increase both mutual trust and commitment as well as rental security.

Recent literature additionally suggests that it makes a difference for the landlord-tenant relationship whether landowners live close by or far away from their land. Absentee landlords have been found to differ from residential landlords, with consequences for conservation measures (P. Petrzelka and Armstrong 2015; Ulrich-Schad et al. 2016). Around one third of our respondents considered the physical distance to landlords as one reason for (the lack of) a tenure effect. This aspect therefore does not appear to be central, but farmers are nevertheless aware of it. The physical distance between landlord and tenant not only has an impact on the personal relationship between both parties but also on how closely landowners can monitor farmers' conduct. This may, in turn, have an impact on tenants' behaviour and care, potentially creating a principal-agent problem. However, further research on this relationship is required.

A third reason that was considered to be important by many respondents as an explanation for why farmers differ their practices between rented and owned plots was a plot's distance to the farmhouse. Rented plots tend to be further away from the farmhouse than owned plots, making travel more time-consuming and costly. This may influence the practices that farmers apply on these plots, especially if measures require multiple trips to a single plot. In our study, we indeed find that respondents' rented plots are further away from the farmhouse than owned plots. However, we do not find any differences in the type of measures or the number of practices applied. One reason for this may be that a mean distance of 3.3 km in our sample is still manageable and may thus not influence soil management. In this regard, a 'typical' plot may also be different from a potential 'extreme' or 'outlier' plot; i.e., while some rented plots might indeed be at a distance to the farm that does have an effect on how that plot is treated, this may not be the typical plot a farmer thinks of when answering the questionnaire.

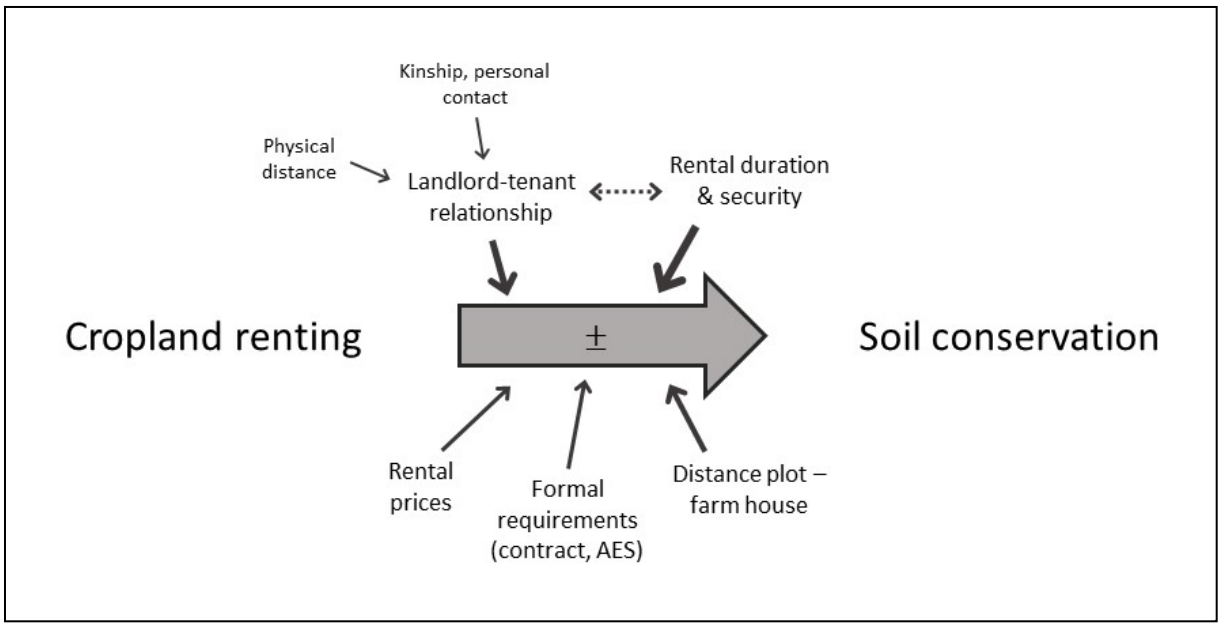
Fourth, our respondents considered agri-environmental schemes an important reason for why there is no effect of renting on soil management. Many of the practices we investigated are part of such subsidized schemes, and in Austria participation in these schemes is generally high. Farmers are often required to apply the subsidized measures on all or a majority of farmed plots, irrespective of ownership status or other characteristics. This will, by default, decrease differences between rented and owned plots for AES participants and may thus be another explanation for the results of this study. However, even for measures that are not part of any AES (e.g., using soil-protecting machinery, precision farming, application of compost, or wind protection elements), we do not see substantial differences, confirming the lack of an overall adverse effect of renting. The same is true for measures that do not need to be applied on the entire farm, such as cover crops. Nevertheless, AES may be an important mechanism counteracting a negative effect of rental on soil management by encouraging conservation measures in general, requiring their application on all plots of a farm. Agreeing on specific measures in a rental contract and thus binding a tenant to their implementation may have a similar effect and be an option for landlords to ensure good soil management. While we do not find contractual obligations to be widespread among our respondents, more than 40 respondents saw the lack of such requirements as a reason why others treat their rented land with less care than their owned land.

One last aspect that we want to discuss here are rental prices. High rents were considered the third most important explanation for a tenure effect. In addition, several respondents provided such a reasoning in the text fields of the survey. The effect of rental prices on soil management may be direct, as in a farmer needing to make an immediate profit from a particular rented plot to compensate for high rental payments. However, it might also have indirect effects, if landlords who are asking for high rents attract tenants who farm intensively and are focused on short-term returns, independent of tenure status of their plots. Both will lead to less conservation on rented land, but only a direct effect will potentially appear in a comparison of rented and owned plots of the same farmer, making overall effects more difficult to detect. While rental prices may not be the most important reason for a tenure effect according to our survey, several respondents expressed concerns about the future developments of land prices and their potential effect.

5 Conclusion

Figure 6 summarizes the factors that influence a potential tenure effect on soil conservation in a simple theoretical model. The duration and security of rental, the landlord-tenant relationship, the distance between a plot and the farmhouse, formal requirements such as contractual agreements and AES, as well as rental prices all have an influence on the relationship between cropland rental and soil degradation. These aspects are of differing importance according to our respondents, with rental duration and security appearing most significant. The landlord-tenant relationship itself depends on details of the relationship, such as the type of landlord and how far away this person lives from their land. Moreover, there is most likely a relationship between the landlord-tenant relationship and contract details, in particular the duration and security of renting. Together with other minor aspects such as farmers' *"fundamental attitude to treat every soil well"*, as well as procedural reasons (such as uniform machinery use, crop rotation plans and small structured and intertwined plots), these factors all appear to work against a potential adverse effect of cropland renting in the Austrian context.

Figure 6: Theoretical model of influences on tenure effect. Line thickness represents theoretical importance.



Our study thus adds to the literature that finds little or no association between the ownership status of land and soil conservation efforts (Prokopy et al. 2019) but provides valuable additional insights about the reasons for this finding. While we could not quantitatively test the relationships described, many of them are supported by qualitative evidence and reasoning. Understanding that a tenure effect is contingent on the factors listed above can be used by policymakers to provide an institutional framework that supports soil conservation on rented land. This may include ensuring long-term oriented rental contracts or capping rental prices through legal requirements, providing templates for rental contracts with soil conservation requirements, supporting positive landlord-tenant relationships by informing landowners about the importance of soil conservation and the value of being in contact with tenants, or establishing platforms to support local rental markets and thereby support geographical proximity between tenants and landlords. Under these circumstances, rental markets can then be an efficient way of allocating agricultural land without adverse long-term effects on soil management.

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